Johns Hopkins University

A GUIDE TO RESEARCH DEVELOPMENT

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Abstract

The global environment of funded research has become increasingly competitive and crowded in recent years. In order for the United States to continue to lead global innovation, it is critical for sponsors and researchers to be cognizant of the impact of their research activities. Given limited budgets and a competitive landscape, it is important for sponsors and researchers alike to invest their resources wisely. Sponsors must invest in research that will have the greatest return on investment (ROI) and researchers need to receive a positive ROI for their time spent developing a proposal and conducting research. Today, the ROI on US government-funded research is not as high as it could be, but research development practices can help address this issue, ultimately leading to more effective and impactful research outcomes.

This project developed a comprehensive Guide to research development to be used by researchers and research administrators in the planning and development of a comprehensive research strategy. This comprehensive Guide to research development introduces the reader to the process behind research strategy as well as highlights a few strategy practices from industry that can be adapted for the research

By following this Guide, a researcher or research institution can approach their project or portfolio strategically and endeavor to produce more meaningful research outcomes. The Guide walks the reader through the three stages of research strategy development: inform, create, and implement.

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Abbreviations

NCR	*National Research Council*
NIH	*National Institute of Health*
NORDP	*National Organization of Research Development Professionals*
PCAST	*President's Council of Advisors on Science and Technology*
PI	*Principal Investigator*
R&D	*Research and Development*
RDO	*Research Development Officer*
ROI	*Return on Investment*
SRAI	*Society of Research Administrators International*
UCI	*University of California Irvine*
UCSC	*University of California Santa Cruz*
U.S.	*United States*

Chapter 1.

INTRODUCTION

1.1. Background

The global environment of funding research has become increasingly competitive and crowded in recent years. In order for the United States to continue to lead global innovation, it is critical for sponsors and researchers to be cognizant of the impact of their funded research activities. From the sponsor's perspective, it is critical for research investments to yield return. For an academic researcher, identifying, acquiring, and executing funded research is no easy task, and it that much more difficult to perform the research in a strategic manner to ensure maximum impact and return on investment (ROI). As a research institution, this investment is most often in man-hours spent developing the initial research proposal.

In 2018, the United States government spent $142.9 billion funding research and development activities.[1] This funding makes up only a portion of the overall research enterprise in the U.S., as funded research dollars also come from private and non-profit entities. According to UNESCO, the U.S.'s current investment in research and development activities totals nearly $500 billion.[2] While the funding levels may seem significant, it is important to consider the level of competition for these funds. In 2017, the National Institute of Health (NIH) funded just over $18 billion worth of research

[1] American Association for the Advancement of Science. (2018). *Historical Trends in Federal R&D.* https://www.aaas.org/programs/r-d-budget-and-policy/historical-trends-federal-rd

[2] UNESCO Institute for Statistics. *How much does your country invest in R&D?* http://uis.unesco.org/apps/visualisations/research-and-development-spending/

grants. NIH awarded funds to 10,123 out of the 54,005 proposals they received.[3] This means that an individual proposal has an 18.7% chance of receiving funding. This is just one example of funding odds, but this low success rate contributes to the overall competitiveness of the research enterprise.

Given limited budgets and a competitive landscape, it is important for sponsors to invest in research that will have the greatest ROI. Unfortunately, it is difficult to measure the impact of the research, which then can be used to assess the ROI. Metrics such as number of publications, case studies, commercialization potential, and peer review are often employed to determine impact. While these metrics can provide insight, the U.S. continues to look for ways in which to increase the ROI from research investments.

1.2. Statement of the Problem

Research and development activities are not well-planned and executed in today's research enterprise. The research enterprise lacks a systems perspective that approaches research as a multi-faceted endeavor that consists of more than technical inputs and outputs, but also includes research strategy, team science, and capabilities and resources management. In recent years, the federal investment in R&D has steadily declined,

[3] Mike Lauer. (2018). *Open Mike*. National Institute of Health. https://nexus.od.nih.gov/all/2018/03/07/fy-2017-by-the-numbers/

further stressing the importance of ROI.[4] While the investment in R&D by industry has increased, U.S. government-sponsored research opportunities are becoming rarer.

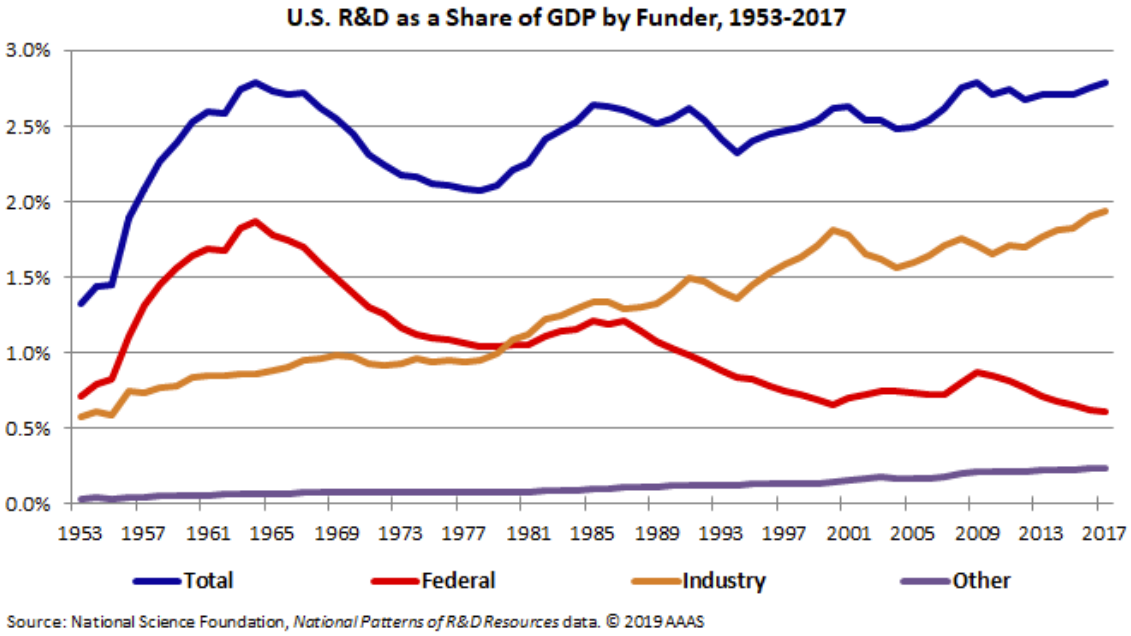

Figure 1: U.S. R&D as a share of GDP

Today, the ROI on US government-funded research is not as high as it could be, but research development practices can help address this issue, ultimately leading to more effective and impactful research outcomes. Per the National Organization of Research Development Professionals (NORDP), the practice of research development includes,

> …strategic, proactive, catalytic, and capacity-building activities designed to facilitate individual faculty members, teams of researchers, and central research administrations in attracting extramural research funding, creating relationships, and developing and implementing strategies that increase institutional competitiveness.[5]

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[4] Matt Hourihan. (2019, March 18). American Association for the Advancement of Science *On Budget Day, A Snapshot of Current R&D Funding.* https://www.aaas.org/news/budget-day-snapshot-current-rd-fundin

[5] Jeff Agnoli. *What is Research Development?* National Organization of Research Development Professionals. https://www.nordp.org/what-is-research-development-

While the practice of research development has been articulated by the National Organization of Research Development Professionals (NORDP) and others, unfortunately no comprehensive Guide for research development to inform the planning and execution of research projects and portfolios exists today.

1.3. Research Questions

To determine the need for a research development Guide, it is important to answer the following questions:

1. What are the current problems related to funded research?
2. What is research development and what aspects of it are most critical to overcoming these problems?
3. What are the best practices in terms of strategy methodologies or approaches that can be adapted and used for research development?

1.4. Project Objectives

The purpose of this project is to develop a comprehensive Guide to research development. This Guide can be used to strengthen the planning and execution of research projects and portfolios in order to increase the impact and effectiveness of research proposals. Secondary to the primary goal, the project seeks to provide insight concerning the current effectiveness and impact of funded research in the United States. This insight will allow government sponsors to access the effectiveness of current sponsored research activities and identify areas where research techniques should be employed to increase impact.

The Guide developed during this project can be used by both researchers and sponsors. For the researcher, the Guide serves as an educational resource on research development practices, include research strategy development. A researcher can use the Guide to inform their research proposal to include a value proposition, which should serve as the basis for any research proposal. A strong value proposition will clearly communicate the value of the research to a sponsor, ultimately increasing the chances of the proposal receiving funding. A funded proposal achieves a positive return on the investment made by the research and their institution in preparing and submitting the proposal.

For a sponsor, the research development techniques can be used to inform research priorities and investments. The Guide will provide the reader with insights regarding the creation and implementation of a research strategy. By utilizing the Guide and employing research development techniques, sponsors can make informed decisions at the portfolio level to promote a positive ROI.

Chapter 2.

PROJECT DESCRIPTION AND NEED ASSESSMENT

2.1. Discussion of Project Elements

This project includes the development of a Guide to research development. This Guide reviews strategic planning methodologies and provides guidance on how to apply them in a research context to receive higher ROI on funded research activities. Additionally, this project includes a thorough review of the current literature regarding the U.S. research enterprise with the intent to answer the research questions outlines above, as well as an analysis of the literature related to research development, including the definition and its current application.

2.2. Need Assessment

In a report published by the National Research Council (NRC), the benefits of scientific research are listed to answer "…why the federal government should continue to invest heavily in scientific training, capacity, and research…"[6] The benefits of research and its discoveries can be seen in Table 1.

Table 1: Benefits of Scientific Research[7]

Benefits of Scientific Research			
Economy	National Security	Health	Agriculture & Infrastructure
Energy	Environment & Natural Resources	Training & Workers	Social Innovation & Policy

[6] National Research Council. (2014). *Furthering America's Research Enterprise.* (p. 7).
[7] Ibid, p. 6.

While it is not difficult to accept that scientific research does have societal benefits, it is much more difficult to track and measure these benefits, and more importantly the ROI of the research. Since July 2013, the U.S. Bureau of Economic Analysis has been treating research and development spending and the related creation of intellectual property as investments rather than expenses.[8] Measuring this investment is challenging, and according to the NRC,

> …The impacts of scientific research can best be determined not by applying traditional metrics such as counts of publications and patents, but by cultivating an understanding of the complex system that is the U.S. research enterprise to determine how all of its component parts interrelate.[9]

The NRC suggests taking a holistic view and considering all the inputs and outputs of the research project and/or portfolio to assess ROI. Inputs include time, funding, and other associated resources, while outputs include findings, inventions, publications, educational value, and other related outcomes.

2.2.1. Establishing the Need

In order to establish the need, it is critical to first consider the current state of the U.S. research enterprise and the existing barriers to increased ROI. This is best accomplished by considering the U.S.'s investment in R&D, followed by an analysis of the current ROI.

[8] Ibid, p. 8.
[9] Ibid, p. 51.

For this project, the need for a comprehensive Guide to research development is made clear by the investment level of U.S. taxpayer dollars in research and development (R&D) activities. It is important to notice that the U.S. government has tried several times to measure the ROI of its investment and has consistently found it difficult to measure and quantify the return. A Guide to research and development would provide structure and process to the planning and execution of funded research activities. Additionally, the need is further established by the apparent lack of research strategy material available to researchers and research institutions.

Table 2: U.S. Investment in Defense, Nondefense and Total R&D, FY 2015-2018[10]

Fiscal Years	2015	2016	2017	2018
Defense	$76.0B	$81.7B	$58.3B	$66.1B
Nondefense	$68.9B	$72.5B	$72.2B	$76.8B
Total	$144.6B	$154.2B	$130.6B	$142.9B

[10] American Association for the Advancement of Science. (2018). *Historical Trends in Federal R&D.* https://www.aaas.org/programs/r-d-budget-and-policy/historical-trends-federal-rd

Chapter 3.

LITERATURE REVIEW

3.1. Overview of Literature Review

The primary sources used for this project are analytical reports prepared under the supervision and direction of the U.S. government, articles and journals written by research professionals with vast experience in the planning and execution of funded research, and articles and books on strategy development methodologies and approaches to strategic planning. The literary review has been organized to address the research questions listed above. The first section, Research Landscape, includes literature related to question one. The second section, Research Development, contains literature that helps define research development and addresses research questions two. And the third section, Strategy, is comprised of literature related to strategy development and industry best practices and addresses research question three.

3.2. Literary Review Details and Applicability: Research Landscape

This project included reviewing and analyzing reports and data related to the current state of the U.S. research enterprise. The literature collected here seeks to address research question one.

In 2012, President Obama asked the President's Council of Advisors on Science and Technology (PCAST) to prepare a report on the future of the U.S. research enterprise. The report argues that science and technology are foundational to American

society and therefore the U.S. must regain and retain its global research and development (R&D) leadership position.

> …a loss of global competitiveness can be avoided by increasing the productivity of U.S. researchers and by positioning the Nation's great research universities and the National Laboratories as central engines of innovation and geographical anchors of the Nation's science and technology enterprise.[11]

The report identifies several key opportunities to enable the preservation of the U.S. innovative advantage, but one such opportunity includes the growth of strategic research portfolios within U.S. government funding agencies.[12] To address this opportunity, the PCAST recommended each agency "…have a strategic plan that explicitly addresses the different kinds of research activities that can contribute to its mission..."[13] While this recommendation is specifically for funding agencies, the creation and implementation of a research strategy to Guide investments should be adopted at all levels of the research enterprise.

As mentioned earlier in this project paper, the sponsored research environment has changed in recently years. The U.S. government is investing less in R&D, leading to greater competition amongst researchers. In 2017, NSF reviewed 203,000 proposals and awarded funds to only 11,000 of those proposals. This equals an award rate of less than 6%.[14] This type of competition and success rate is not unusual. A survey conducted at the

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[11] President's Council of Advisors on Science and Technology. (2012). *Report to the President: Transformation and Opportunity: The Future of the U.S. Research Enterprise* (p. 1).
[12] Ibid, p. 7.
[13] Ibid, p. 8.
[14] National Science Foundation. (2018). *FY 2017 Performance and Financial Highlights.* (p. 1). https://nsf.gov/pubs/2018/nsf18021/nsf18021.pdf

University of Michigan found that of 195 researcher who applied for U.S. federal funding between 2009 and 2012 stated that they spent 116 hours on average developing the proposal.[15] Given the competition and the investment required to pursue federal funding, it is important for research institutions to implement practices to increase the chances of a return, in the form of sponsored research dollars, on that investment.

3.3. Literary Review Details and Applicability: Research Development

This project included reviewing articles and journals related to the definition and practice of research development. The literature and resources collected here address research question two: What is research development and what aspects of it are most critical to overcoming these problems?

A research development professional is a technical individual who "…uses their soft skills to help push research forward." In an article in the National Postdoctoral Association, Samarpita Sengupta described research development professionals as "…planners, strategists, and figure-it-out-ers."[16]

As the funding market becomes more competitive, the role for research development becomes more critical. The research development community is looking to brand a vital function that is often overlooked within the research community while also

[15] Richelle Weihe. (2017, November). *ROI on Proposals*. https://mcircc.umich.edu/latest-news/2017/11/13/roi-on-proposals

[16] Samarapita Sengupta. (2017, October). *Research Development: A Career for the Planners, Strategists, and Figure-it-out-ers.* National Postdoctoral Association. Vol. 15, No. 10. https://www.nationalpostdoc.org/page/postdocket_10174

emphasizes the need for research development to facilitate and lead effective and impactful research. Research development professionals are…

> …the people who make big team science projects happen by guiding faculty, fellows, and students through the process of generating ideas, designing projects, setting up collaborations, seeking funding sources, preparing…a grant application, and assisting with successful execution of research projects, as well as completing a grant term or preparing progress reports and manuscripts.[17]

While the research community lacks a comprehensive Guide to research development, the practice of research development is gaining traction within the research community and the Society of Research Administrators International (SRAI) recently began offering a certificate in research development. This certificate is designed for professionals who support the development of research strategies to enhance and expand an institution's research agenda. The certificate curriculum is particularly focused on ways in which to grow a funded research portfolio by improving the number, size, and quantity of awarded grants.[18]

Currently, the greatest contingent of research development professionals is found in academia. Several large research universities, including the University of California Irvine (UCI), have research development professionals. At UCI, the research development team sits within the Office of Research and report directly to the Vice Chancellor of Research. Each research development officer (RDO) is matrixed to a different school on campus, where they work directly with faculty to identify funding

[17] Ibid
[18] Society of Research Administrators International. *Research Development Certificate Programs*. https://www.srainternational.org/programs/certificate-programs/research-development

opportunities and help develop compelling proposals. The UCI RDOs provide four primary services to the university and its faculty:

- Identify funding opportunities
- Facilitate proposal development
- Conduct workshops and trainings on proposal development
- Provide grantsmanship advice and strategy[19]

At the University of California Santa Cruz (UCSC), research development practices are used to increase research funding productivity. While research development is not new to UCSC, the university has taken strides to "…professionalize these services to a greater degree in order to help faculty thrive in an increasingly competitive research landscape." Services provided by UCSC's Office of Research Development include the following:

- Align research interests/capabilities with funding opportunities
- Provide support for early career researchers
- Enhance research opportunities for UCSC graduate programs
- Facilitate development of large scale initiatives and new centers
- Implement a proactive and coordinated RD approach that ensures that proposals are competitive, complete, compliant, timely, and successful[20]

[19] University of California Irvine Office of Research. *Research Development Support in the Office of Research*. https://www.research.uci.edu/research-development/index.html
[20] UC Santa Cruz Office of Research. *Research Development Process*. https://officeofresearch.ucsc.edu/ord/process.html

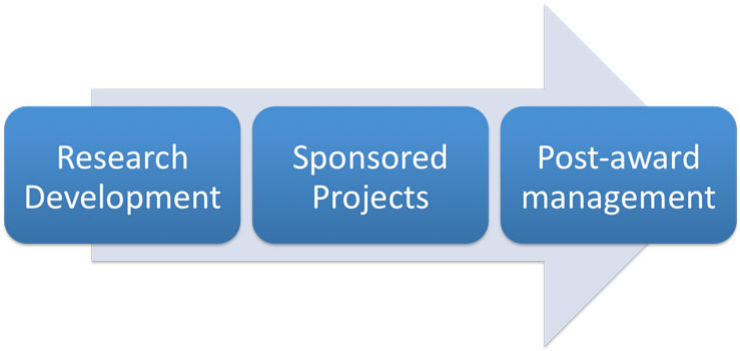

Figure 2: Research Development Cycle at UC Santa Cruz[21]

3.4. Literary Review Details and Applicability: Strategy

This project included reviewing articles and books that provide guidance and recommendations related to strategy development and strategic planning practices.

Historically, the research community has not used strategic planning as a tool to increase research impacts. Given the lack of government research-specific strategy frameworks, it is important to consider approaches that exist in other sectors such as industry. Companies perform strategic planning to ensure their relevance to the market. The research community should do the same to ensure their relevance to the U.S. research enterprise. According to Boston Consulting Group (BCG), there are four keys to strategic planning:

1. Explore strategy at distinct time horizons
2. Consistently reinvent and stimulate the strategic dialogue
3. Engage the broader organization
4. Invest in executing and monitoring[22]

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[21] Ibid

[22] Boston Consulting Group. (2016, April). *Four Best Practices for Strategic Planning.* https://www.bcg.com/en-us/publications/2016/growth-four-best-practices-strategic-planning.aspx

While these keys may seem specific to industry, they can be tailored and applied to a research context. When considering strategy at different time horizons, BCG suggests approaching strategy with three different perspectives: long term, mid-term, and short-term. Approaching strategy with a variety of time lenses allows the process to be multi-dimensional and flexible. The second key is to question the status quo and frequently engage in strategic dialogue. "Great strategists—and great business leaders—have to learn the "art of questioning."[23] Instead of reinventing the process, BCG suggests reinventing the dialogue to foster new ideas and discoveries.

The third key is engaging the broad organization, both internally and externally. One of the inhibitors of strategic planning is "groupthink." "Goupthink" is where a diverse team of individuals from different generations, cultures, and backgrounds will support varied thoughts and ideas. According to the NRC, successful research requires "…[drawing] on diverse field to bring fresh perspectives to stale problems."[24]

Finally, without an investment in implementation and execution, all strategies will remain ineffective. This is where strategies can turn into results or paperweights. Another best practice from industry strategy development is Simon Sinek's *Start with Why. Start with Why* walks the reader through the Golden Circle, which begins with answering the why, which is followed by the how, and then finally the what.[25] For this project, these

[23] Ibid
[24] National Research Council. (2014). Furthering America's Research Enterprise. (p. 38).
[25] Simon Sinek. (2013). *Start with Why: How Great Leaders Inspire Everyone to Take Action*. London: Portfolio/Penguin.

keys and best practices are incorporated into the research development Guide to help create a strategy for developing a successful proposal.

Chapter 4.

METHODOLOGY AND PROJECT DESIGN

4.1. Methodology Overview

The data collected to support this project was primarily obtained through published literature. This approach allowed for a comprehensive understanding of the U.S. research enterprise, as well as a thorough knowledge of the critical components of research development. Strategy theories and methodologies were evaluated to determine their relevance for planning and executing research. This consideration allowed for the incorporation and tailoring of meaningful strategy practices to be used in the research domain.

The following methodology was used to develop the Guide:

- Articulate the research questions
    a. What are the current problems related to funded research?
    b. What is research development and what aspects of it are most critical to overcoming these problems?
    c. What are the best practices in terms of strategy methodologies or approaches that can be adapted and used for research development?
- Conduct literature review and analyze findings
    a. Research Landscape
    b. Research Development
    c. Strategy
- Apply the findings to address research questions

- Develop an informed Guide

The output of this project is arranged in the format of a Guide. This Guide identifies relevant strategy best practices and adapts them for application in a research context. The Guide then walks the reader through the three primary stages of research development: inform, create, and implement.

4.2. Project Design and Discussion

The project was designed to enable the development of a Guide to research development. For the Guide to be pertinent and valuable, it needed to be informed by a review of the U.S. research landscape. The design of this prokect included the articulation of research questions related to the research enterprise as well as research development practices, followed by a thorough literature review. This literature review allowed for the collection of information related to the U.S. research enterprise, research budgets and investment, and the practice of research development. The findings of the literature review were analyzed and used to inform the Guide.

The Guide itself was developed as a two-page pocket reference for research development. The Guide provides convenient, concise pieces of information to advise the application of research development practices to strengthen the planning and execution of research projects and portfolios in order to increase the impact and effectiveness of research activities. It was critical for the Guide to be succinct to allow for easy comprehension and application.

Chapter 5.

PROJECT RESULTS

5.1. Project Result: The Guide

The purpose of this project was to develop a concise, comprehensive Guide to research development to be used to inform the planning and execution of funded research in the U.S. to increase the impact of the project. This project resulted in the development of a two-page handout that can be used to inform, create, and implement a research strategy. By following this Guide, a researcher or research institution can approach their project or portfolio strategically and endeavor to produce more meaningful research outcomes. The Guide walks the reader through the three stages of research strategy development: inform, create, and implement.

5.1.1 Inform

When creating a research strategy, there are three different stages. First, it is important to begin by collecting information to inform the research approach and strategy. This step includes performing market research to ascertain the external landscape. Relevant topics to research during this step include potential sponsors, who else might be doing similar research, what is industry doing in this field, and what has been done in the past. This information can be used to inform potential partnerships as well as research topics to avoid due to a crowded market.

5.1.2 Create

Once the research landscape has been reviewed, it is time to create the research strategy. This strategic plan should be focused on the research topic of interest, and it will be used to guide the planning and execution of the research. Creating a research strategy includes several steps. These steps are articulated below and can also be found in the Guide (see Appendix 1).

To begin, research institutions should consider research strategy at long term, mid-term, and short-term time horizons. The purpose of long-term strategic planning is to define, validate, and/or refine the vision, mission, and direction of the institution. While this may seem removed from individual research projects, the outcome of this strategic planning should influence internal investments such as proposal development funds. For example, if National Renewable Energy Laboratory (NREL) refined its vision to focus solely on wind energy, it is likely that energy grid research may receive less internal 1resources than the wind energy program.

Additionally, the outcome of long-term strategic planning should help articulate the research institution's value proposition. Strong value propositions are critical to the overall success of a research proposal, as well as any funded research project. Value propositions should answer the "why us?" question and clearly communicate the institution's uniqueness and its ability to perform impactful research. "Any strategy lives or dies on the basis of its…value proposition."[26]

[26] Frank V. Cespedes. (2015, August). *Any Value Proposition Hinges on the Answer to One Question.* Harvard Business Review. https://hbr.org/2015/01/any-value-proposition-hinges-on-the-answer-to-one-question

One framework that can be useful when drafting a strategy is the "Golden Circle." This approach to strategy is well-articulated in Simon Sinek's *Start with Why.* The Golden Circle includes three phases, with an emphasis on "why." In the book, Sinek askes his readers to start with the clarity of why, which can only be found in knowing and articulating purpose and belief.[27]

After the why has been established, the Golden Circle focuses on the discipline of how. This includes articulating the strengths, values, and guiding principles.[28] This can be modified for a research development Guide by focusing on what makes the research institution, the researcher, or the research idea unique.

Finally, once the why and how have been answered, the framework asks you to define the what. In a commercial context, this includes the products or services offered. In a research context, technical capabilities, facilities, and expertise fall into "the what."[29]

Now, with the why, how, and what in hand, a research institution can then develop a clear and concise value proposition. This value proposition should be utilized when developing funding proposals and it should communicate to a potential sponsor why this specific institution and this specific researcher are right for this opportunity.[30]

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[27] Sinek, Simon. (2013). *Start with Why: How Great Leaders Inspire Everyone to Take Action*. London: Portfolio/Penguin.
[28] Ibid
[29] Ibid
[30] Ibid

Medium-term or mid-term strategic planning addresses the more tactical side of the planning process. This time horizon focuses on transforming "…vision into value."[31] This is where a research roadmap becomes relevant and necessary. Mid-term strategic planning focuses on the portfolio-level research.

Short-term strategic planning is where individual research projects should be considered. As proposals are developed, they should be evaluated to determine synergy with the mid-term and long-term strategies. Short-term planning also includes continuously re-evaluating the current strategy and assessing progress made against it. The Heilmeier Catechism, described below, can be used during this phase as well to dive deeper into the research idea and communicate the purpose, value, and potential impact.

When developing a strategy, it is important to adapt and evolve. BCG recommends consistently reinvesting and stimulating the strategic dialogue.[32] The process shouldn't look the same every single time, and neither should the questions. To garner valuable input for the strategy, it is important to approach if from different, new, and unexpected angles. The Heilmeier Catechism and its questions can assist in the rousing of research strategy.

The Heilmeier Catechism is a set of questions that can be used to think through a proposed research activity. The questions were developed by former Defense Advanced

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[31] Boston Consulting Group. (2016, April). *Four Best Practices for Strategic Planning.* https://www.bcg.com/en-us/publications/2016/growth-four-best-practices-strategic-planning.aspx

[32] Boston Consulting Group. (2016, April). *Four Best Practices for Strategic Planning.* https://www.bcg.com/en-us/publications/2016/growth-four-best-practices-strategic-planning.aspx

Research Projects Agency (DARPA) director, George Heilmeier, and have applicability for both research agendas or portfolios as well as individual projects. These questions are designed to help researchers communicate an idea as well as the value of their proposed research. These questions can be applied at both the portfolio level as well as the project level. The catechism includes eight questions:

1. What are you trying to do? Articulate your objectives using absolutely no jargon.
2. How is it done today, and what are the limits of current practice?
3. What is new in your approach and why do you think it will be successful?
4. Who cares? If you are successful, what difference will it make?
5. What are the risks?
6. How much will it cost?
7. How long will it take?
8. What are the mid-term and final "exams" to check for success?[33]

For the purposes of this project, the catechism will be incorporated into the research development Guide.

Finally, the outcome of strategic planning is only as good as it input. To accomplish a meaningful strategy, BCG emphasizes the importance of a diverse team.[34] This tip is particularly important in the research context as multi-disciplinary teams are not only more likely to make research discoveries, they are also more likely to receive funding from an external sponsor.

[33] Defense Advanced Research Projects Agency. *The Heilmeier Catechism.* https://www.darpa.mil/work-with-us/heilmeier-catechism
[34] Boston Consulting Group. (2016, April). *Four Best Practices for Strategic Planning.* https://www.bcg.com/en-us/publications/2016/growth-four-best-practices-strategic-planning.aspx

> As interdisciplinary projects gain recognition and visibility…because they often offer novel approaches to traditional problems, federal agencies have increased funding opportunities for interdisciplinary research…[35]

When developing a research strategy, is also important for the team to include technical experts from different generations, schools of thought, and other diverse perspectives. The varied inputs will facilitate new ideas and fresh perspectives, ultimately leading to a novel, unique research strategy.

5.1.3 Implement

The implementation of the strategy is the final step in strategic planning. Without an investment in implementation and continued monitoring, the strategy will have little impact. According to BCG, if the strategy is clearly communicated across the institution, natural implementation and progress is more likely to occur.[36] In a research context, it is important for the entire research team to know and understand the strategy to ensure execution. Finally, strategic plans required continued investment to allow for the plan to be operationalized. Too often thousands of dollars are invested into strategic planning and then once the plan is developed, the money is shut off. This ultimately decreases the impact of the exercise by stalling the strategy in its final stage.

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Chapter 6.

RECOMMENDATIONS

6. Recommendations

Through the course of this project, it became clear that there is a lack of literature on how researchers, research portfolio managers, and research institutions can increase and ensure ROI, both for their sponsors as well as for their institutions. The U.S. government has requested and authored many reports looking for ways in which to track the ROI of research dollars, but upon review of these documents, it is clear research development techniques should be endorsed and implemented to facilitate greater ROI.

The implementation of research development practices can not only help institutions and PIs become more effective at acquiring funded research, but also help the U.S. government sponsors ascertain the impact of its investment in research. The Guide developed through this project does not look to reinvent the wheel but rather leverages existing techniques from industry to inform research strategy and the Guide researchers and research institutions through research development practices.

Recommendation 1: Utilize the Guide to Research Development

Prior to this project, there was not a published, comprehensive understanding of research development and its associated techniques. Furthermore, the research community lacked a Guide to research development. This project established research questions to assess the need for such a Guide. Informed by a through literary review and analysis, this Guide (see Appendix 1) was developed to inform the planning and

execution of research projects and portfolios to increase the impact and effectiveness of the research. This Guide can affect the ROI from the perspective of the researcher as well as the sponsor. As a researcher, this Guide can be used to develop a compelling value proposition. The value proposition can then be integrated into a proposal submission and contribute to the overall impact of the proposal. If the proposal is selected for funding, the researcher and their respective institution receive a return on their investment in the proposal development. As a sponsor, the Guide should be used across the research enterprise to encourage and facilitate research strategy to ensure impactful research. By adopting the techniques and best practices outlined in the Guide, the U.S. government may see higher return on its investment in R&D activities.

Chapter 7.

CONCLUSION

Many countries are investing a greater percentage of their GDP in research and development than the U.S., and therefore it is critical for the U.S. to maintain its technical edge by investing in research activities that produce an ROI.[37] This ROI can only be achieved through the mindful planning and execution of research. Today, R&D activities are not well-planned and executed in today's research enterprise, but the implementation of research development practices can be used to increase the impact of research. While research development is a nascent field, it has demonstrated value in informing the planning and execution of funded research activities.

With limited budgets and a competitive landscape, it is important for sponsors to invest in research that will have the greatest ROI. This project demonstrated the need for research development and ultimately resulted in the development of a Guide. This Guide highlights the fundamentals to research development and provides a detailed Guide to strategy development. This Guide can be used to inform and plan research activities to enable impactful research results.

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APPENDICES

Appendix 1. A Guide to Research Development

May 2019

A Guide to Research Development

By Hannah Stangebye
Johns Hopkins University

WHAT IS RESEARCH DEVELOPMENT?

Research development (RD) is the practice of making research happen. According to the National Organization of Research Development Professionals (NORDP), research development is the practice of generating ideas, leading and contributing to strategic planning, designing projects, setting up collaborations, seeking funding sources, and assisting with the execution of successful research projects.

RD techniques can be used to the inform the planning and execution of research projects and portfolios, and ultimately increase the impact of the research outcomes.

This comprehensive guide to RD introduces the reader to the process behind research strategy as well as highlights a few strategy practices from industry that can be adapted for the research context.

THREE STEPS OF RESEARCH STRATEGY DEVELOPMENT

INFORM	CREATE	IMPLEMENT
Perform market research and analysis to assess the external landscape and ascertain the need for this specific research project or portfolio.	Develop strategy at three distinct time horizons	Continue to invest in the implementation and monitoring of the strategy
Know what your competitors and partners are doing	**Long-Term** Leverage "*Start with Why*" and develop a compelling value proposition	Clearly communicate the strategy and its intent
Evaluate the internal climate	**Mid-Term** Develop a research portfolio roadmap to guide the strategy development	Break the strategy down into actionable steps
Identify champions	**Short-Term**	
Obtain leadership buy-in	Leverage the *Heilmeier Catechism* to drill down into technical detail and flesh out strategy	Develop quantitative metrics and goals to measure progress against the strategy
Identify internal stakeholders and assemble the team		

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BCG's BEST PRACTICES

Historically, the research community has not used strategic planning as a tool to increase impact.

The research community should leverage industry best practices to ensure their relevance to the U.S. research enterprise. According to Boston Consulting Group (BCG), there are four keys to strategic planning:

1. **Explore strategies at distinct time horizons**
   - Long-Term | Mid-Term | Short-Term
2. **Consistently reinvent & stimulate strategic dialogue**
3. **Engage the broader organization**
4. **Invest in executing & monitoring**

See references below for link to additional BCG information!

HEILMEIER CATECHISM

The Heilmeier Catechism is a set of questions, developed by George Heilmeier, that can be used to think through a proposed research activity.

They applicability for both research agendas or portfolios as well as individual projects.

These questions are designed to help researchers communicate an idea as well as the value of their proposed research. These questions can be applied at both the portfolio level as well as the project level. The catechism includes **eight** questions:

1. What are you trying to do? Don't use jargon.
2. How is it done today? What are the limits of current practice?
3. What is new in your approach and why will it be successful?
4. Who cares? What difference will it make?
5. What are the risks?
6. How much will it cost?
7. How long will it take?
8. What are the mid-term & final "exams" to check for success?

START WITH WHY

Simon Sinek's *Start with Why* and the "Golden Circle" are the perfect tools to use when developing a research value proposition (VP). This VP can be used to articulate the value of your project, idea, institution, etc.

WHY: Start with the **clarity of why**. This is where you articulate purpose, belief and value. Simon argues that people don't buy what you sell but rather what you believe. In a research context, this can be rephrased to communicate that sponsors don't fund your proposal, they fund your passion, your value, your belief.

HOW: After you know the "why", focus on the **discipline of how.** To communicate the how, you must articulate your strengths, values, and guiding principles.

WHAT: With the why and how answered, turn your focus to the **consistency of what**. In a commercial context, this includes the products or services offered. In a research context, technical capabilities, facilities, and expertise fall into the "what."

WHY RESEARCH DEVELOPMENT?

Given limited budgets and a competitive landscape, it is important for sponsors to invest in research that will have the greatest ROI. Unfortunately, it is difficult to measure the impact of the research, which then can be used to assess the ROI. Research development techniques, including research strategy can help increase the impact of a research proposal, project, or portfolio.

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Appendix 2. Biography

The author, Hannah Stangebye, completed her undergraduate education at the University of New Mexico with a Bachelor of Arts Degree in Technical Writing. While in college, Hannah interned at Sandia National Laboratories as a Competitive Intelligence Specialist. Following graduating, she began working at Sandia full-time and soon became a Technical Business Development Specialist in the Integrated Military Systems Center. It was here that Hannah discovered a strong interest for research strategy and research partnerships. This interest lead her to pursue a Master of Science in Research Administration at Johns Hopkins University. Hannah hopes to continue to influence national research strategies using her expertise and experience as a Research Development Professional.